

CLAIMS

WHAT IS CLAIMED IS:

1. A method for fabricating a coating for an implantable medical device, the method comprising:
 - 5 (a) forming a first layer of the coating on the device, the first layer including at least one hydrophobic polymer; and
 - (b) forming a water-soluble second layer of the coating on at least a portion of the first layer, the second layer including at least one hydrophilic or amphiphilic polymer.
2. The method of Claim 1, wherein the implantable medical device is a stent.
- 10 3. The method of Claim 1, wherein the hydrophobic polymer has a Hildebrand solubility parameter lower than about 9.9 (cal/cm³)^{1/2}.
4. The method of Claim 1, wherein the hydrophobic polymer is selected from a group consisting of poly(ethylene-co-vinyl alcohol) and poly(*n*-butyl methacrylate).
- 15 5. The method of Claim 1, wherein the hydrophobic polymer is selected from a group consisting of poly(vinyl acetate), poly(ethylene-co-vinyl acetate), poly(vinyl acetals), poly(methyl methacrylate), poly(ethyl methacrylate), poly(*n*-propyl methacrylate), poly(*iso*-propyl methacrylate), poly(ethyl methacrylate-*co*-*n*-butyl methacrylate), poly(*iso*-butyl methacrylate), poly(methyl acrylate), poly(ethyl acrylate), poly(*n*-propyl acrylate), poly(*iso*-propyl acrylate), poly(*n*-butyl acrylate), poly(*iso*-butyl acrylate), poly(vinyl chloride),
- 20 poly(vinyl fluoride), hexamethylene-1,6-diisocyanate-butanediol-*co*-polydimethylsiloxane, poly(vinylidene chloride), poly(vinylidene fluoride), poly(hexafluoropropene),

poly(hexafluoropropene-co-vinylidene fluoride), poly(ethylene-co-hexafluoropropene),

polytetrafluoroethylene, and blends thereof.

6. The method of Claim 1, wherein the hydrophilic polymer has a Hildebrand solubility parameter of higher than about 10.1 (cal/cm³)^{1/2}.

5 7. The method of Claim 1, wherein the hydrophilic polymer is selected from a group consisting of poly(propylene glycol), poly(ethylene oxide-co-propylene oxide), hyaluronic acid, poly(2-hydroxyethyl methacrylate), heparin, poly(vinyl pyrrolidone), chondroitan sulfate, chitosan, glucosaminoglycans, dextran, dextrin, dextran sulfate, cellulose acetate, carboxymethyl cellulose, hydroxyethyl cellulose, cellulosics, poly(trimethylene 10 glycol), poly(tetramethylene glycol), polypeptides, polyacrylamide, polyacrylimide, poly(ethylene amine), poly(allyl amine), and blends thereof.

8. The method of Claim 1, wherein the amphiphilic polymer has a Hildebrand solubility parameter of between about 9.9 and about 10.1 (cal/cm³)^{1/2}.

9. The method of Claim 8, wherein the amphiphilic polymer is poly(ethylene 15 glycol) or poly(ethylene oxide).

10. The method of Claim 1, wherein the first layer further includes at least one hydrophilic or amphiphilic polymer.

11. The method of Claim 1, wherein a mass ratio between the hydrophobic polymers and the hydrophilic polymers in the first layer is within a range of between about 20 49:1 and about 19:1.

12. A coating for an implantable medical device, comprising:

- (a) a first layer disposed on the device, the first layer including at least one hydrophobic polymer; and
- (b) a water-soluble second layer disposed on at least a portion of the first layer, the second layer including at least one hydrophilic or amphiphilic polymer.

5 13. The coating of Claim 12, wherein the hydrophobic has a Hildebrand solubility parameter lower than about 9.9 (cal/cm³)^{1/2}.

14. The coating of Claim 12, wherein the hydrophobic polymer is selected from a group consisting of poly(ethylene-co-vinyl alcohol) and poly(*n*-butyl methacrylate).

15. The coating of Claim 12, wherein the hydrophobic polymer is selected from a group consisting of poly(vinyl acetate), poly(ethylene-co-vinyl acetate), poly(vinyl acetals), poly(methyl methacrylate), poly(ethyl methacrylate), poly(*n*-propyl methacrylate), poly(*iso*-propyl methacrylate), poly(ethyl methacrylate-*co*-*n*-butyl methacrylate), poly(*iso*-butyl methacrylate), poly(methyl acrylate), poly(ethyl acrylate), poly(*n*-propyl acrylate), poly(*iso*-propyl acrylate), poly(*n*-butyl acrylate), poly(*iso*-butyl acrylate), poly(vinyl chloride), poly(vinyl fluoride), hexamethylene-1,6-diisocyanate-butanediol-*co*-polydimethylsiloxane, poly(vinylidene chloride), poly(vinylidene fluoride), poly(hexafluoropropene), poly(hexafluoropropene-*co*-vinylidene fluoride), poly(ethylene-*co*-hexafluoropropene), polytetrafluoroethylene, and blends thereof.

16. The coating of Claim 12, wherein the hydrophilic polymer has a Hildebrand solubility parameter of higher than about 10.1 (cal/cm³)^{1/2}.

17. The coating of Claim 12, wherein the hydrophilic polymer is selected from a group consisting of poly(propylene glycol), poly(ethylene oxide-co-propylene oxide), hyaluronic acid, poly(2-hydroxyethyl methacrylate), heparin, poly(vinyl pyrrolidone), chondroitan sulfate, chitosan, glucosaminoglucans, dextran, dextrin, dextran sulfate, cellulose acetate, carboxymethyl cellulose, hydroxyethyl cellulose, cellulosics, poly(trimethylene glycol), poly(tetramethylene glycol), polypeptides, polyacrylamide, polyacrylimide, poly(ethylene amine), poly(allyl amine), and blends thereof.

18. The method of Claim 12, wherein the amphiphilic polymer has a Hildebrand solubility parameter of between about 9.9 and about 10.1 (cal/cm³)^{1/2}.

10 19. The coating of Claim 18, wherein the amphiphilic polymer is poly(ethylene glycol) or poly(ethylene oxide).

20. The coating of Claim 12, wherein the first layer further includes at least one hydrophilic or amphiphilic polymer.

21. The coating of Claim 12, wherein a mass ratio between the hydrophobic polymers and the hydrophilic polymers in the first layer is within a range of between about 49:1 and about 19:1.

22. A method of surface modification of a coating on an implantable medical device, the method comprising:

20 (a) forming a first layer of the coating on the device, the first layer including a hydrophobic polymer and a first hydrophilic or amphiphilic polymer; and

(b) forming a water-soluble second layer of the coating on at least a portion of the first layer, the second layer including a second hydrophilic or amphiphilic polymer; and

(c) dissolving the second layer in an aqueous medium to produce a coating layer having higher concentration of the first hydrophilic or amphiphilic polymer on the outer 5 surface thereof than the average concentration of the first hydrophilic or amphiphilic polymer throughout the coating layer.

23. The method of Claim 22, wherein the hydrophobic polymer has a Hildebrand solubility parameter lower than about $9.9 \text{ (cal/cm}^3\text{)}^{\frac{1}{2}}$.

24. The method of Claim 22, wherein the hydrophobic polymer is selected from a 10 group consisting of poly(ethylene-co-vinyl alcohol) and poly(*n*-butyl methacrylate).

25. The method of Claim 22, wherein the hydrophobic polymer is selected from a group consisting of poly(vinyl acetate), poly(ethylene-co-vinyl acetate), poly(vinyl acetals), poly(methyl methacrylate), poly(ethyl methacrylate), poly(*n*-propyl methacrylate), poly(*iso*-propyl methacrylate), poly(ethyl methacrylate-*co*-*n*-butyl methacrylate), poly(*iso*-butyl 15 methacrylate), poly(methyl acrylate), poly(ethyl acrylate), poly(*n*-propyl acrylate), poly(*iso*-propyl acrylate), poly(*n*-butyl acrylate), poly(*iso*-butyl acrylate), poly(vinyl chloride), poly(vinyl fluoride), hexamethylene-1,6-diisocyanate-butanediol-*co*-polydimethylsiloxane, poly(vinylidene chloride), poly(vinylidene fluoride), poly(hexafluoropropene), poly(hexafluoropropene-*co*-vinylidene fluoride), poly(ethylene-*co*-hexafluoropropene), 20 polytetrafluoroethylene, and blends thereof.

26. The method of Claim 22, wherein each of the first and the second hydrophilic polymer has a Hildebrand solubility parameter of higher than about $10.1 \text{ (cal/cm}^3\text{)}^{\frac{1}{2}}$.

27. The method of Claim 22, wherein each of the first and the second hydrophilic polymer is selected from a group consisting of poly(propylene glycol), poly(ethylene oxide-co-propylene oxide), hyaluronic acid, poly(2-hydroxyethyl methacrylate), heparin, poly(vinyl pyrrolidone), chondroitan sulfate, chitosan, glucosaminoglycans, dextran, dextrin, dextran sulfate, cellulose acetate, carboxymethyl cellulose, hydroxyethyl cellulose, cellulosics, poly(trimethylene glycol), poly(tetramethylene glycol), polypeptides, polyacrylamide, polyacrylimide, poly(ethylene amine), poly(allyl amine), and blends thereof.

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10 28. The method of Claim 22, wherein the each of the first and the second amphiphilic polymer has a Hildebrand solubility parameter of between about 9.9 and about 10.1 (cal/cm³)^{1/2}.

29. The method of Claim 28, wherein each of the first and the second amphiphilic polymer is poly(ethylene glycol) or poly(ethylene oxide).